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Impact of Rural Residence on Survival of Male Veterans Affairs Patients After Age 65

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Abstract

Objectives: More than 1 in 5 Veterans Affairs (VA) users lives in a rural setting. Rural veterans face different barriers to health care than their urban counterparts, but their risk of death relative to their urban counterparts is unknown. The objective of our study was to compare survival between rural and urban VA users.

Methods: We linked the Large Health Survey of Veteran Enrollees conducted in 1999 to the Veterans Administration vital status registry. We used time-to-event regression models controlling for patient race, education, ZIP-code median income, and marital and smoking status.

Findings: Of the 372,463 male veterans of age 65 or greater, 80,931 lived in rural settings. Age-adjusted mortality was 5.9% higher (95% CI, 4.5%-7.2%) in rural residents compared to urban residents. After adjusting for age, education, and ZIP-code median income, rural residents had 3.0% lower mortality (95% CI, 1.5%-4.4%). Compared to urban and suburban VA users, rural VA users' mortality at age 65 was 12% lower, but this advantage gradually diminished by age 75.

Conclusion: Mortality after the age of 65 for male VA users is higher in rural dwellers than in urban dwellers. However, among veterans of the same socioeconomic characteristics, rural-dwelling veterans have up to 15% better mortality than urban-dwelling veterans until the age of 75.

Key words long-term survival, observational data, rural health, veterans.

Rural-dwelling Americans face different health and health care access challenges than urban residents. Before 1970, analyses suggested that rural residents had higher mortality rates; however, the observed disparity was later explained by the older age of rural populations.[1] Analysis of the National Longitudinal Mortality Study[2] of residents of the United States between the ages of 55 and 75 found that rural-dwelling residents have lower mortality (adjusted for age, sex, race, education, income, and marital status) than urban residents; however, this difference disappears with increasing age.[3] A similar survival advantage of rural-dwelling residents in comparison to urban-dwelling residents was found using a probability sample of American residents older than 24 years.[4]

The Veterans Health Administration (VA) provides comprehensive health care services to veterans across the United States and treats a population that is sicker, older, and of lower socioeconomic status than the general population.[5] Military recruits are increasingly drawn from rural areas[6]; consequently, a growing proportion of VA users live in rural settings.[7] Several studies suggest that rural-dwelling VA users have greater health care needs

than their urban counterparts, as measured by health-related quality-of-life scores, even after adjusting for sociodemographic and clinical factors.[8-10] These differences in health-related quality-of-life scores were substantial, likely to have clinical meaning, and likely to be associated with increased demand for health care services.[11]

We hypothesized that rural VA users would have a higher mortality rate than urban VA users. We tested this hypothesis in male VA users of age 65 or greater, by linking a 2006 vital status registry of veterans to a large national health survey of veterans conducted in 1999.

Methods

We used information from the 1999 "Large Health Survey of Veteran Enrollees."[12] This survey was administered by mail to more than 1.4 million veterans, with a 60% response rate. It was completed by over 845,000 veterans. It is available by request from the VA's Office of Quality and Performance in Washington, DC. The survey captured information on age, race, educational level, health insurance status, smoking status, and ZIP code of residence. We restricted our analysis to male VA users who were at least 65 years of age in 1999 (N = 372,463).

We used the ZIP codes recorded in the survey to calculate 2 variables:

1. *Rural-Urban Commuting Area* (*RUCA*)*-defined urban, suburban, large town, and rural residence*. To identify veterans as living in urban or rural settings, we used RUCA codes developed by the Health Resources and Service Administration's federal Office of Rural Health Policy, the Department of Agriculture's Economic Research Service, and the Washington, Wyoming, Alaska, Montana, and Idaho (WWAMI) Rural Health Research Center at the University of Washington School of Medicine.[13] We used the Washington State Department of Health's RUCA consolidation system[14] to collapse these codes into 4 broader categories: Urban, Suburban, Large Town, and Rural, which are characterized as follows. Urban areas are contiguous areas of 50,000 persons or more; for example, cities. Suburban cores have high commuting flows to urban areas. Large towns have populations between 10,000 and 49,999. Rural areas are towns with populations less than 10,000 and more than an hour's drive to the nearest city.
2. *Median income of the ZIP code.* We obtained median annual family income levels for the ZIP code of residence by using US Census data to estimate respondents' income level*s*. This is a marker of the socioeconomic status of the community where the VA user lived in 1999.

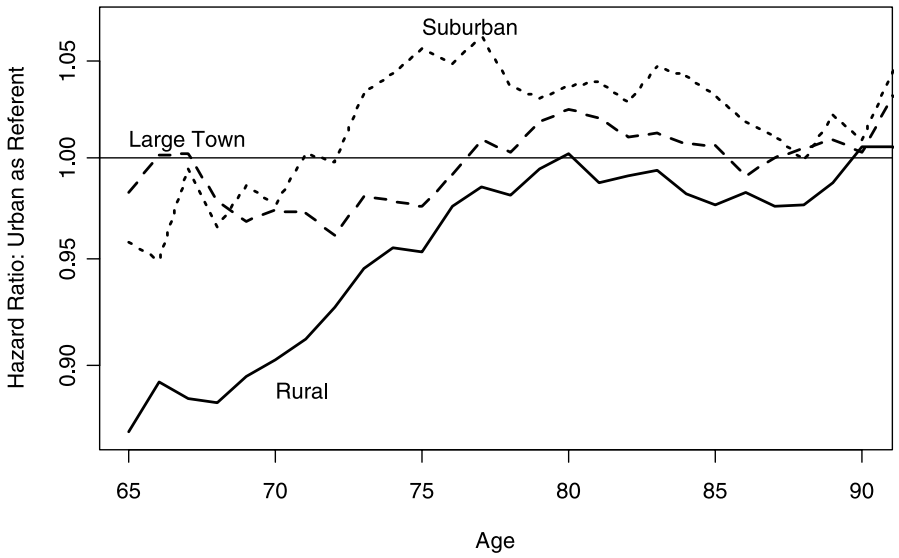
We linked 1999 survey and vital status data through 2006 using unique veteran social security numbers. The vital status registry of the VA Information Resource Center[15] is based on 4 data sources: the Beneficiary Identification and Record Locator Subsystem, the Patient Treatment File, the VA-Medicare file, and data from the Social Security Administration. These datasets allowed us to examine mortality follow-up through April 2007. This study was approved by the Committee for Protection of Human Subjects at Dartmouth College, as study CPHS #16872.

We estimated the probability of death by age using the Kaplan-Meier estimator for left-truncated data,[16] which was used in turn to calculate annual mortality. We compared survival across RUCA levels using Cox's model for left-truncated data (ie, age specified as the time-scale, as opposed to time since survey completed),[17] with age at survey specified as the beginning of the follow-up interval and age at death or last known age alive specified as the end of the interval. This is an optimal way of accounting for the effect of age on survival because estimation of hazard ratios for dwelling and other covariates is based on comparisons of individuals of exactly the same age (as opposed to individuals in the same age category). It makes inclusion of age as a covariate in Cox's model superfluous, but it returns age-adjusted hazard ratios. Age-adjusted and adjusted hazard ratios are reported using urban residents as the referent group. Tests of effect modification were done using Wald tests for interactions of RUCA with each of the covariates. Subgroup analysis was performed by repeating the analyses in selected subgroups. The age-dependent hazard ratios reported in Figure 1 were obtained using Cox's model adjusted as above and restricted to age groups within 5-year windows (ie, a rectangular smoother of width 5).

Results

Table 1 shows the characteristics of 372,463 male VA users over the age of 65 who completed the survey. Among respondents, 55% lived in urban settings, 9% in suburban, 14% in large towns, and 22% lived in rural settings. The age distribution was similar across settings, with mean ages of 74.5, 74.0, 74.2, and 74.0, respectively. There were significantly higher proportions of blacks, Hispanics, and Asians ($P < .0001$ for each race) living in urban settings than living in each of the 3 other nonurban settings. The proportion of VA users who were college graduates or had some college education increased monotonically and significantly ($P < .0001$) across the 4

Figure 1 Relative Mortality of Rural, Large Town, and Suburban Veterans Versus Urban Veterans as a Function of Age, Adjusted for Race, Education, Median ZIP-Code Income, Marital, and Smoking Status



rural-urban settings from 22% in rural VA users to 38% in urban VA users. Smoking was slightly but significantly ($P < .0001$) less prevalent in urban settings. The proportion of married VA users was 72% for those dwelling in rural, large town, or suburban areas, compared to 66% for urban dwellers, which was significant ($P < .0001$). The median income of the ZIP code the VA user lived in at the time of the survey ranged from $32,000 in rural VA users and $34,000 in large town VA users, up to $43,000 in suburban and $45,000 in urban VA users ($P < .0001$).

Overall, 1-year mortality increased from 3.3% (SE = 0.1) at age 65, to 6.0% (SE = 0.1) at age 75, to 10.8% (SE = 0.1) at age 85, to 21.6% (SE = 0.3) at age 95. Table 2 presents the age-adjusted and multivariable-adjusted hazard (ie, mortality incidence) ratios for each of the RUCA categories as well as covariates. Rural-dwelling VA users had increased mortality when compared to urban VA users, hazard ratio = 1.06 (95% CI, 1.05-1.07) in analyses adjusted for age but no other covariates. VA users from large towns had a similarly increased morality hazard, hazard ratio = 1.06 (95% CI, 1.04-1.08), while suburban VA users had 1.05 (95% CI, 1.03-1.07) times the hazard. Blacks had significantly better-adjusted mortality, as did Asians and Hispanics. As education level increased, survival increased significantly. Relative to high school graduates, college graduates had more than 20% better survival. VA users who reported no smoking were at half of the mortality rate of those who reported smoking every day. VA users who were not married at the time of the survey had 13% to 23% more incident mortality than married VA users. Survival significantly increased with higher median ZIP-code income.

After adjusting for these variables, rural-dwelling VA users had 3% lower incident mortality than urban VA users (95% CI, 1%-4%, $P < .0001$), VA users from large towns were at equal hazard (95% CI, .98-1.02), while suburban VA users were at 3% (95% CI, 1%-5%, $P = .002$) increased hazard when compared to urban VA users. We tested for but found no significant interactions ($P > .05$ for all).

Table 3 shows, for a variety of subgroups, the adjusted incident mortality ratios for the comparison of rural, large town, and suburban to urban VA users. There was no significant modification (ie, interaction) of the adjusted association of rural-dwelling status with survival, by education ($P > .05$), smoking ($P > .05$), or marital status ($P > .05$). Race significantly ($P < .0001$) modified the adjusted association between rural-dwelling status and survival. In particular, Hispanics had different patterns of associations between rural-dwelling status and survival compared to whites as shown in Table 3. Median ZIP-code income significantly ($P = .002$) modified the difference in survival between urban and large town VA users.

The advantage that rural VA users had over urban VA users in adjusted survival rates decreased significantly with increasing age ($P < .0001$). Figure 1 shows the adjusted hazard ratio for rural, large town, and suburban VA users relative to urban VA users as a function of age. Rural VA users experienced 12% (95% CI, 8%-17%) lower adjusted mortality between the ages of 65 and 70.

Table 1 Characteristics of Male Veterans Over 65 by Urban/Rural Categories

	Urban N = 205,917		Suburban N = 34,262		Large Town N = 51,353		Rural N = 80,931	
Age at Survey	%	N	%	N	%	N	%	N
65 to 69	26.5	54,529	29.7	10,160	27.7	14,237	28.9	23,350
70 to 74	26.7	54,960	27.4	9,394	28	14,398	28.6	23,112
75 to 79	29.5	60,695	28.5	9,762	28.7	14,738	27.9	22,595
80 to 84	13.6	28,009	11.7	3,993	12.5	6,422	11.9	9,609
85 and older	3.8	7,724	2.8	953	3	1,558	2.8	2,265
Race								
White	81.6	167,943	92.3	31,628	91.5	46,985	92.5	74,865
Black	12.9	26,592	4	1,387	5.1	2,605	4.5	3,655
Asian	0.9	1,802	0.4	121	0.4	202	0.1	103
Hispanic	3.8	7,767	2.2	739	2	1,027	1.5	1,215
Pacific Islander	0.2	351	0.1	43	0.1	57	0	31
Native American	0.7	1,462	1	344	0.9	477	1.3	1,062
Education								
None	0.2	401	0.2	54	0.3	127	0.3	268
Grades 1-8	15	29,016	21.8	7,041	23.7	11,426	28.1	21,525
Grades 9-11	17.8	34,388	17.8	5,757	18.2	8,779	18	13,777
Grade 12 or GED	28.8	55,569	30.4	9,812	31.3	15,128	31.4	24,069
Some college	22.4	43,318	18.8	6,073	17.2	8,305	14.7	11,291
College grad	15.8	30,475	11	3,563	9.4	4,533	7.4	5,664
Smoking status								
Everyday	10.5	20,015	11.2	3,589	11.5	5,516	11.8	8,948
Some days	3.9	7,479	3.3	1,053	3.6	1,711	3.6	2,738
Not at all	85.6	163,874	85.5	27,319	84.9	40,788	84.5	63,884
Marital status								
Married	66.1	135,248	72	24,549	72.3	36,952	72.2	58,178
Divorced	12.4	25,479	10.9	3,719	10.7	5,466	10.7	8,631
Separated	2.3	4,673	1.5	523	1.5	787	1.7	1,331
Widowed	13.9	28,515	12.3	4,188	12.4	6,334	11.9	9,602
Never married	5.2	10,743	3.3	1,117	3.1	1,571	3.5	2,815
Median income ($1,000s)								
<30	16.9	34,882	8.1	2,768	23.1	11,835	38.1	30,796
30-39	31.4	64,673	33.4	11,423	59.1	30,321	50.5	40,869
40-49	23.7	48,725	30.7	10,509	16.1	8,281	9.8	7,946
50+	28	57,594	27.9	9,546	1.7	887	1.6	1,300

However, this advantage disappeared by age 80. Rural VA users' survival advantage before the age of 75 was not significant ($P > .10$) without adjustment for education and median ZIP code income.

Discussion

We tested the hypothesis that mortality was associated with rurality among male VA users of age 65 or greater. We found that the age-adjusted mortality rate was higher among rural VA users than urban VA users. However, after adjusting for educational level and median ZIP-code annual income, rural-dwelling VA users had as much as 12% lower mortality than urban-dwelling VA users at age 65; the survival advantage lasted up to the age of 75.

We found that the survival advantage for rural VA users compared to urban VA users with the same sociodemographic characteristics was about half as large without adjustment for neighborhood income or educational achievement status. The role of adjustment for median ZIP-code income deserves consideration. Housing is less expensive, on average, in rural locations compared to urban locations. Therefore, VA users living in a rural neighborhood of a given median income, say $30,000, may be better off economically than urban VA users living in a neighborhood of the same income.

The difference in mortality between rural- and urban-dwelling VA users was modified by neighborhood income. The rural survival advantage was apparent only in VA users for whom the median ZIP-code income was

Table 2 Mortality Ratios With 95% Confidence Intervals Comparing Urban/Rural and Other Sociodemographic Categories in Male Veterans Over 65

	Age Adjusted*			Age & Multivariable Adjusted†		
Risk Factor	Hazard Ratio	95% Confidence Interval		Hazard Ratio	95% Confidence Interval	
Dwelling status						
Urban	1			1		
Suburban	1.05§	1.03	1.07	1.03‡	1.01	1.05
Large town	1.06§	1.04	1.07	1.00	0.98	1.02
Rural	1.06§	1.04	1.07	0.97§	0.96	0.99
Race						
White	1			1		
Black	1.06§	1.04	1.07	0.90§	0.89	0.92
Asian	0.71§	0.66	0.76	0.75§	0.69	0.81
Hispanic	0.83§	0.80	0.85	0.75§	0.72	0.78
Hawaiian	0.84	0.72	0.97	0.87	0.74	1.03
Native American	1.19§	1.14	1.25	1.05	0.99	1.11
Education						
None	1.21§	1.11	1.32	1.22§	1.11	1.34
Grades 1-8	1.16§	1.14	1.17	1.12§	1.11	1.14
Grades 9-11	1.09§	1.08	1.11	1.07§	1.05	1.09
Grade 12 or GED	1			1		
Some college	0.90§	0.88	0.91	0.91§	0.89	0.92
College grad	0.77§	0.76	0.78	0.81§	0.79	0.82
Smoking status						
Every day	1			1		
Some days	0.83§	0.81	0.86	0.85§	0.82	0.87
Not at all	0.51§	0.50	0.52	0.54§	0.54	0.55
Marital status						
Married	1			1		
Divorced	1.32§	1.30	1.34	1.23§	1.20	1.25
Separated	1.37§	1.32	1.42	1.25§	1.20	1.29
Widowed	1.19§	1.17	1.21	1.13§	1.11	1.15
Never married	1.23§	1.20	1.25	1.17§	1.14	1.20
Median ZIP-code income						
<$30,000	1			1		
$30,000-$39,999	0.94§	0.93	0.96	0.97§	0.95	0.98
$40,000-$49,999	0.90§	0.89	0.92	0.94§	0.93	0.96
$50,000 or higher	0.81§	0.80	0.82	0.88‡	0.86	0.89

*Age is the time scale in this left-truncated Cox model so that all hazard ratios are calculated controlling for age, but no hazard ratios for age are generated.
†Adjusted for age, dwelling status, race, education, smoking status, marital status, and median ZIP-code income.
‡$P \leq .01$.
§$P \leq .0001$.

less than $35,000. In more affluent communities, rural location was not associated with improved survival rates. A similar but more extreme modification existed with respect to VA users classified as living in large towns: these VA users had higher survival rates when compared to urban VA users if the median neighborhood income was less than $35,000, but they had significantly lower survival rates when the neighborhood income exceeded $35,000.

Recently, the VA has established the Office of Rural Health, and its subsidiary Rural Health Resource Centers, which are charged with testing and implementing care models to improve access for rural veterans. VA users living rurally face greater barriers to accessing care than do urban VA users, often due to longer traveling times and lack of public transportation. Our results suggest that this barrier does not seem to impair their survival. We have shown previously that rural VA users' access to VA and non-VA primary and specialty health services is lower compared with urban VA users,[18-22] but others have shown that the availability of more health care, and more specialized care in urban environments, does not necessarily increase longevity.[23,24] While factors other than health care access likely explain the relative survival

Table 3 Subgroup Analyses: Adjusted Hazard Ratios (and Standard Error) of Suburban, Large Town, and Rural-Dwelling Veterans Versus Urban-Dwelling Veterans*

	Suburban	Large Town	Rural
Overall	1.03 (0.01)	1.00 (0.01)	0.97 (0.01)
White	1.03 (0.01)	0.99 (0.01)	0.97 (0.01)
Black	1.03 (0.05)	0.99 (0.03)	0.99 (0.03)
Hispanic	1.15 (0.09)	1.23 (0.09)	0.96 (0.06)
Smokes every day	1.02 (0.03)	0.98 (0.02)	0.96 (0.02)
Smokes some days	1.03 (0.05)	1.00 (0.04)	0.99 (0.04)
Smokes not at all	1.03 (0.01)	1.00 (0.01)	0.97 (0.01)
High school or <	1.03 (0.01)	1.01 (0.01)	0.98 (0.01)
Some college	1.12 (0.03)	1.00 (0.02)	0.98 (0.02)
College grad	1.00 (0.03)	0.99 (0.03)	0.96 (0.03)
Married	1.02 (0.01)	0.99 (0.01)	0.96 (0.01)
Not married	1.06 (0.02)	1.03 (0.02)	0.98 (0.01)
Median ZIP-code income <$35,000	0.97 (0.02)	0.97 (0.01)	0.96 (0.01)
Median ZIP-code income >$35,000	1.05 (0.01)	1.05 (0.01)	1.00 (0.01)

*Adjusted for age, dwelling status, race, education, smoking status, marital status, and median ZIP-code income.

advantage of rural VA users over their more urban counterparts, it is possible that the restricted access to health care actually improves mortality outcomes.[23,24] Among the known risk factors that affect urban and suburban areas more than rural areas are air pollution,[25] poor water quality,[26] motor vehicle accidents,[27] pedestrian accidents,[28] and a relative lack of social capital. Social capital is known to enhance psychological well-being, perhaps mitigating other disadvantages.[29] Conversely, behaviors that increase health risks such as smoking, physical inactivity, and poor nutrition are increased among rural-dwelling individuals.[30] While the relative impact of these combined factors is unknown, our analysis suggests that, overall, living in a rural setting is protective against mortality, at least until age 75.

Our study has several limitations. First, while the 1999 Large Health Survey of Veterans was a very large random survey, the response rate was 60%, and the sample may not be representative of the population of VA users. Second, the VA Vital Status File is subject to some misclassification, which may bias mortality comparisons between rural and urban VA users if the classification of vital status differs between RUCA levels. For example, our finding of a lower mortality in rural veterans would be the result if deaths of rural-dwelling subjects are less likely to be captured than deaths of urban-dwelling subjects. However, we have no reason to suspect such a bias. Third, survey respondents' residence during the survey year (1999) may not represent their residence locale before or after the survey, which would bias mortality ratios toward the null. Fourth, there may be some bias in our analysis: older veterans who are able to live independently in rural settings where health care may be restricted may have a greater likelihood of surviving than those who move to the city specifically to access care. Finally, the differences we have identified between rural and urban veterans may be due to omitted confounding variables.

Further research should address cause of death, and whether or not the differences in mortality between rural and urban veterans are due to any particular forms of chronic diseases. Importantly, health care provision must be adequate for a given population *as it presents itself*. While we revealed an apparent rural advantage after statistical manipulation by adjusting for patient factors that worsen health, in reality the rural VA user population remains older, sicker, and poorer than its urban counterpart. The VA is therefore justified in its efforts to improve health care access to rural veterans.

Summary

Mortality after the age of 65 for male veterans is higher in rural dwellers than in urban dwellers. However, among veterans of the same socioeconomic characteristics, rural-dwelling veterans have up to 15% better mortality than urban-dwelling veterans until the age of 75.

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